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Pasture improvement

Melbourne

[1930]

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Pasture Improvement

Proposals
for the formation
of Pasture Improvement
Clubs in State
Schools

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Box 296

Reprinted from "The Argus"

Published by
The Proprietors of "The Argus" and "The Australasian,"
Melbourne.

FOR GRATUITOUS DISTRIBUTION.

FOREWORD

As the result of the discussion on Pasture Improvement at the Conference of District Organisers of Horticulture held last January, the committee of the Victorian State Schools' Horticultural Society decided to establish Pasture Improvement Clubs among the children of the Victorian schools.

It is recognised that if the children are interested in this movement it will have a stimulating effect on the residents of a district,

These clubs may be formed among the children and the work taken as part of the work in Rural Science.

The committee feels confident that teachers and others will take up this national work, and bring it to a successful issue.

In the accompanying articles, which the proprietors of "The Argus" and "The Australasian" have so kindly reprinted, will be found much valuable information and directions for carrying on these clubs.

We heartily thank all those who have assisted so freely to help on this work, and now it remains with the teachers and children to show their appreciation of these efforts by the number of clubs that will be formed in each district.

Trusting that many will be able to help this movement.

We are,

Yours faithfully,

F. A. MOORE, President.

F. A. HUGHES, Secretary.

Victorian State Schools' Horticultural Society.

Hughesdale,
April 4, 1930.

Oct. 30, 1930 DA/HEC

PASTURE IMPROVEMENT

TEACHING YOUNG FARMERS

CLUBS FOR STATE SCHOOLS.

"The Argus" to Co-operate.

Following a series of articles published in "The Argus" last December, directing attention to the possibility of improving pastures, particularly in areas having a rainfall of more than 20 inches, and in irrigation districts, two letters from correspondents were published suggesting the formation of a better pasture committee. Mr. E. Jackson, of Goldsbrough, Mort Pty. Ltd., then suggested that pasture clubs for young farmers should be formed.

Representations were made to the proprietors of "The Argus" and "The Australasian" asking for their practical support, and the proprietors cordially complied with the request, having in view the immense importance of interesting young people in the movement. Pasture is Australia's greatest crop, but that to which the least attention has been paid. Great advances have been made in other avenues of production, such as those of luscious fruits and vegetables, and nutritious cereals from plants, which, in their native state, were practically valueless as food. There is an even more extensive field to be opened by pasture improvement which will bring increased prosperity to all connected with the stock-raising industries, and will materially add to Australia's wealth. The proprietors of "The Argus" and "The Australasian" believe that this can best be done by stimulating public interest in the projected movement.

Stock clubs have been formed in many centres in Victoria and other States. In the United States there are hundreds of stock clubs which are interesting thousands of young farmers in various phases of stock husbandry. The Gala Calf Club, in Geelong, is the oldest organisation of this kind in Victoria, and already the success achieved by these young stockmen has exerted a wonderful influence in the improvement of dairy stock throughout the district. The exhibits paraded by members of the Gala Calf Club make one of the most impressive spectacles at the Geelong Agricultural Show. Stock clubs have been formed in several State schools, and at a score or more schools "home project" clubs have been formed under the auspices of the Education department. These are all doing excellent work, but under present conditions their scope is limited, inasmuch as each animal has an individual owner and collective interest is not possible. Moreover, many young people are so situated that they cannot undertake the keeping and breeding of stock. A pasture improvement club might well interest thousands of young people.

It is an old saying among stockmen that "half the breeding goes down the throat." This is true, for no matter how well-bred an animal may be it will never attain perfection of form or maximum of utility or productiveness unless it be properly nourished. Breeding and feeding must go together if stock-raising industries are to be carried on efficiently and successfully. There is still another aspect of the question to be considered. In every part of the Commonwealth are to be found stock suffering more or less from deficiency diseases, due to the failure of natural pastures to provide adequate supplies of nutrients for their full development. Many pastures lack proteins for the production of muscular tissues, and in others there is a deficiency of mineral materials, mainly phosphate of lime, for the development of bone. Animals grazing upon such pastures can never become a source of profit to their owners. There are scores of stockowners whose work is unremunerative because the carrying capacity of their lands is inadequate to enable a profit to be made upon heavy capital charges. For example, a dairy farmer having land valued at £35 an acre, the carrying capacity of which is one cow to three acres, is faced with the impossible task of trying to make one cow pay interest and show a profit upon £105 worth of land. If the expenditure of £3 an acre

for grass seed and manure enables him to carry one cow to 1½ acres of land, his capital burden is reduced to £36 for a cow area. Many farmers have done even better than this; they are carrying one cow to the acre upon improved pasture with better methods of pasture management, involving rotational grazing of small areas. Similarly in the sheep industries many farmers have increased the carrying capacity of their land from one sheep to the acre to three, five, or more.

Education Department's Sympathy.

It is abundantly clear, therefore, that there is room for extensive development in live stock industries by means of pasture improvement. This phase of agriculture promises to do for the live stock industries what improved methods of cultivation and the use of artificial fertilisers have done for the wheat farmer. This improvement can best be brought about by an educational movement, hence the suggestion for the establishment of pasture improvement clubs for young farmers is sound. The State Schools' Horticultural Society is a movement initiated by the teachers, with the approval of the director of Education, and although now subsidised by the department it is controlled by a committee of teachers. When the committee was approached with the suggestion that pasture improvement methods should be added to its activities the proposal was readily adopted, and the hearty approval of the director of Education (Mr. Hansen) and the chief inspector (Mr. J. McRae) was immediately given. The supervisor of the State Schools' Horticultural Society (Mr. F. Hughes) and the president (Mr. F. A. Moore) took the opportunity to have the proposal explained at a meeting of district organisers from all parts of the State. These men, in whom "the spirit of true citizenship" is deeply implanted, saw in it the germ of a great national work, and they are anxious to interest the farmers in their respective districts. The Schools' Horticultural Society already has the organisation for carrying out the work. There are 30 districts, each in charge of an organiser, and there are 1,250 schools affiliated with the society. It is proposed that, for the present, a number of teachers, probably 10 in each district, be invited to undertake to sow and tend one or more plots, an area of one square rod being adopted as a unit. An advisory committee will be formed to recommend the variety of pasture plants to be cultivated.

It is felt that, for the present at least, the number of varieties should be restricted to, say, four or five, such as English rye, cocksfoot, and white clover, for districts of heavy rainfall and irrigation areas, and Wimmera rye and subterranean clover for districts having a rainfall of about 20 inches It is proposed that the teachers shall act as secretary of the club, and that a member of school committee, agricultural society, or some other interested person should be invited to supervise plots in each district. The Royal Agricultural Society and district societies will be asked to include a section for exhibits of pasture produce, accompanied by a card giving all particulars of treatment and results, and young farmers outside the schools will be invited to join the organisation. There is no limit to the scope of work that might be undertaken outside by interested members. For example, a farmer might be induced to undertake the small experiment of sowing 3lb. of subterranean clover seed, mixed with 1cwt. of superphosphate, upon one acre of land, to be used as a demonstration plot for the benefit of members of the club. Another might undertake the establishment of an acre of mixed pasture upon thoroughly cultivated land.

Certificates for Schools.

The proprietors of "The Argus" and "The Australasian" gladly associate themselves with this movement, and they will supply to the schools all printed and instructional matter to enable the project to be successfully initiated and carried on. They will also present a certificate to the school in each district providing the best demonstration of pasture improvement, and merit cards to other schools whose efforts are considered worthy of special recognition. In addition, by publicity and in every other practical way, they will help to develop and extend a general campaign for pasture improvement. Better pastures mean better stock, increased carrying capacity, and greater prosperity for all.

Educational Plans Endorsed.

Suggestions made met with the ready endorsement of many authorities engaged in agricultural and educational development. Generally the opinion was expresssed that any movement that had as its objective an extension of knowledge relating to the increased production of nutritious fodder grasses would exert considerable influence on the prosperity of the State. It is realised that the best means of encouraging interest in this problem is by the conduct of an educational campaign, designed primarily to interest the younger generation, and by widespread publicity of results gained in a practical manner, and accurately checked and tabulated. The formation of pasture improvement clubs on somewhat similar lines to those followed in the establishment of calf clubs is regarded as offering wide educational possibilities. In this respect the full co-operation of the Education department is assured. Similarly the Department of Agriculture, through the director of Agriculture (Dr. S. S. Cameron), has promised to make available all the information gained by experts who for years have been conducting comprehensive trials and experiments. In this and in other directions the Department of Agriculture will take a very active part in the campaign.

The director of Education (Mr. M. P. Hansen), who welcomed the suggestion, said that his department was particularly

anxious to interest young people in all branches of rural production. There was an immense amount of work that could be done in awakening interest in the growth of more and better pastures. Results obtained in the Western district and in Gippsland following the adoption of proper systems of using artificial fertilisers indicated the tremendous benefits that would be derived from the systematic improvements effected by the wise selection of suitable pasture grasses and their subsequent proper treatment. This matter had already been discussed by inspectors of the Education department at a recent conference, and it was felt that means could be devised for interesting young people in this work. The extent to which departmental officers could assist the movement by the development of pasture improvement clubs had not yet been determined, but it was intended that every encouragement would be given to the advancement of the movement.

The suggestion that the Royal Agricultural Society of Victoria should be asked to include a section for exhibits of pasture produce was referred to by Mr. H. Schwieger, manager of the society. A section was already included in the schedule, he said, that would permit of large displays of this class of produce being made. The Royal Agricultural Society and the Chamber of Agriculture were anxious to encourage children to take an interest in subjects of this kind. His society would give favourable consideration to any request for the extension of these activities.

Professor M. Wadham said that as a representative of the Council for Scientific and Industrial Research, which had recently made a visit of inspection of the Gippsland areas, he was keenly interested in the subject of pasture improvement. A tremendous amount of valuable work could be done in the encouragement of pasture development. In any undertakings of an educational or practical nature the movement could be assured that every action taken to that end would receive every assistance from the council.

Example of New Zealand.

The opinion that a policy of progressive pasture improvement would be the salvation of large tracts of country in South Gippsland was expressed by Mr. E. J. Stock, general manager of the National Mutual Life Association of Australasia. Mr. Stock said that there was no part of the State in which the care and management of pasture land could not be practised to advantage. He strongly commended the practice of farmers laying down a small area to nutritious grasses each year. In this way and at a relatively small cost great improvement could be made in the carrying capacity of the land. Large areas now overrun with bracken and other useless vegetation could be made highly productive. With the facilities provided by the Country Roads Board thousands of acres had been brought within reach. The land was capable of being reclaimed and developed to a high degree of productivity by the growth of suitable pastures.

A well-known business man closely associated with the agricultural conditions of the State who returned recently from New Zealand said that the attempt to develop a realisation of what good pastures meant to the Commonwealth was the most important undertaking attempted on behalf of the agricultural community. The importance of good pastures was far from sufficiently realised by all sections. New Zealand was in a far better position at present than any Australian State. That he attributed to the fact that the Government and the farming community had realised the value of good pastures as a factor in national wealth. In periods of difficulty the Dominion was able to retrieve the situation as rapidly as the Commonwealth, because owing to the enormous extent to which pasture land had been developed means of increased production were very limited. In many parts of New Zealand grass lands were carrying 10 sheep to the acre. The Government had given the closest possible attention to the character and selection of the pasture grass seed which it allowed to be distributed. Growing pastures used for the production of seed were examined to ensure that before stripping the variety was true to type. As the crops were threshed they were sealed by departmental officers, and later they were watched through the cleaning processes to ensure the absolute purity of the seed distributed. Apart from the careful preparation of the land for laying down pastures every care was taken to prevent disappointment from the resultant crop. In Victoria, while grade standards were imposed to ensure the correct analyses of the fertilisers distributed, nothing was done to ensure the trueness to type and reliability of the seed circulated. It was of little use applying costly fertilisers to encourage the growth of the seed and grasses that would not eventually give satisfaction to the farmer. Pasture development had taken an important part in the prosperity of the farming and pastoral community in New Zealand, and it was capable of adding considerably to the wealth and progress of Victorian farmers. No other factor deserved closer attention.

Gippsland Examples.

In districts where there is an assured rainfall, such as Gippsland, there is almost unlimited scope for pasture improvement. For some years the progressive policy of the National Mutual Life Association in converting waste land into rich pasture country has attracted much attention. In less than five years Mr. A. C. Witton has succeeded in converting a number of deserted properties into highly productive

areas. These properties are in the Yinnar, Boolarra, Foster, and Hiawatha districts, and are thoroughly representative of many thousands of acres of South Gippsland country that is at present regarded as worthless.

A beginning was made with the reclamation of the Yinnar property four years ago. It has an area of 474 acres, and already 300 acres have been cleared, ploughed, cropped, and sown down with a mixture of pasture grasses, consisting of subterranean clover, white Dutch clover, cocksfoot, and rye grasses. This was poor heath country, with soil of a sandy, spewy character. Of the pasture area, 100 acres are now in their third year. The remaining 200 acres consist of first-year pasture. This one-time valueless land has for some months carried 2,000 sheep and a truck of dry cattle. Last winter the 100-acre area lambed down five ewes to the acre, with an average of 86 per cent. of lambs, some of which later weighed up to 65lb. The rainfall average for the district is between 32in. and 35in., and, despite one of the driest summers on record, the 300 acres of pasture are still carrying 1,000 lambing ewes in excellent condition, in addition to the cattle. It is claimed that this year the carrying capacity of the land will be increased by the sole formed by the newer pasture.

The mixture used to form this pasture consisted of subterranean clover, 3lb.; cocksfoot, 10lb.; rye grass, 10lb.; and Dutch clover, 2lb. It was originally top-dressed with a bag of superphosphate to the acre. The practice of top-dressing at the rate of 1cwt. an acre each year is being followed. As a result of this treatment land that four years ago was covered with heath and bracken and was worth little or nothing is now valued at £20 an acre. This has been accomplished at a cost of about £12 an acre, the expenditure including fencing, buildings, shearing-sheds, subdivision into paddocks, tree-planting, and other improvements.

A similar example of the remarkable improvements effected by laying down pastures is provided at Boolarra, where a property of 700 acres has been reclaimed for profitable use. When taken over three years ago the land was in an abandoned condition similar to that at Yinnar. All the land has been cleared and ploughed, bracken ferns, rabbits, and other pests have been destroyed, and 500 acres of land have been laid down in permanent pasture, while 200 acres are under rape and millet, which will be followed by pasture this year. Subterranean clover, white Dutch clover, and cocksfoot grasses have saved the poor country, while on the better land a mixture of rye, cocksfoot, and white and red clovers is laying the foundation of a rich pasture. For seven or eight months this land has carried 3,300 sheep, 30 bullocks, and about 20 horses. A draft of 2½-year-old bullocks from the property sold at Morwell this week for more than £15 a head, while frequent consignments of wethers have commanded top prices at the Newmarket sales. When the reclamation of the area has been completed it is expected to lamb 5,000 ewes.

The rainfall at Foster is greater than at either of the other centres mentioned, and there a property of 300 acres of abandoned blackberry and bracken covered country is being restored to a condition of high production by means of pastures. Within the last three years 250 acres have been cleared for permanent pasture. For a period of several months the land has carried 2,000 sheep, 105 beef cattle, and about 50 vealers. The richness of this young pasture is indicated by the fact that 50 head of vealers were recently sold at £6/3/ a head, while in April, 1929, a draft of bullocks averaged £22/10/ a head on the farm. The value of this country in three years has been increased from a nominal amount to about £30 an acre by the replacement of blackberry and bracken with a judicious selection of pasture grasses.

Irrigation Areas.

It is significant that even in the northern irrigated portions of the State, where ample water supplies are available and where permanent lucerne fields can be established, numbers of dairy farmers are giving their attention to the laying down of permanent pasture areas. This development is taking place in conjunction with the growth of lucerne. Apar entirely from the great bulk of succulent feed thus obtained, there is the fact that the stock relish the change of feed and that this in turn has a marked influence on production. There are many instances in the rich Goulburn Valley areas in which the addition of a few acres of scundly selected pasture grasses has been of immense value to those engaged in dairying. Kerang may be taken as another instance in which irrigation has been of aluable assistance in enabling farmers to supplement their fodder supplies by the addition of introduced pastures, and so enable the sheep-carrying capacity of the land to be increased enormously

In the normal course of events adjoining farmers, benefiting by the example set by an enterprising neighbour, are being induced to lay down small areas of pasture land. In like manner the practice of applying an annual dressing of superphosphates to natural pasture is extending Far more rapid progress than that suggested is justified by what already are accomplished facts. There is every incentive to those engaged in all branches of primary production to interest themselves in the various means whereby increased quantities of rich, nutritious pasture may be grown on any available area normally used for the grazing of stock.

The committees of district agricultural societies are usually comprised of men prominently associated with primary production, and often for the most part they consist of farmers chiefly interested in sheep, cattle, and horses. These associations may rightly be looked to to take a leading part in encouraging any development likely to influence the progress and prosperity of their districts. Credit is due to the Tongala Agricultural Society for having undertaken the conduct of an annual pasture competition. This example might well be followed by many another similar organisation. As an irrigation settlement the schedule of points awarded is naturally based on the conditions in which the crops are grown, and for the purpose of serving as a guide to others they are set out as follows: — Layout of the land for irrigation, 60 points; condition of channels, 60 points; condition of herbage, 60 points; uniformity of pasture, 60 points; variety, 60 points; and absence of weeds, 60 points; total, 300 points. This competition has attracted good entries each season, and, as a consequence, a very real interest is being taken by farmers in the district in the question of pastures. The competition is worthy of adoption by other agricultural societies similarly situated. In the last competition many good pastures, ranging from about four acres in extent upwards, were entered. The event was won by Mr. T. A. Coombes, whose field of four and a half acres was laid down in 1928. The mixture used contained perennial rye 20lb.; cocksfoot, 5lb.; cowgrass, 2lb.; white clover, 2lb.; alsiki clover, 1lb.; and subterranean clover, 1lb. Although this mixture is not identical with that suggested by the Department of Agriculture, it differs mainly in the quantities of seed used of the varieties recommended. The suitability of the mixture to the district is perhaps best emphasised by the fact that it was used with slight modifications by many exhibitors, who showed wonderfully good pasture. The mixture recommended for irrigation pasture by experts of the Department of Agriculture is made up of perennial ryegrass 10lb., Italian rye 3lb., cocksfoot 3lb., cowgrass 2lb., white clover 1lb., alsiki 1lb., and subterranean clover 1lb.

In these northern irrigated districts autumn sowing is recommended. After being well worked, the land should be firmed down to provide the seed-bed, and when possible the seed should be mixed with the superphosphate and sown through the manure run of the drill with the tubes hanging free. With the spring growth well established, light grazing may rapidly be followed by heavy stocking, making provision for the pasture to receive occasional rests. Heavy grazing, when once the roots are firmly established, helps to compact the land, and it prevents the more vigorous growing grasses from becoming rank, in which condition they are largely neglected by the stock. The short growths are both sweeter and more nutritious, and, when properly rested, they provide almost unlimited feed supplies. In a number of instances it has been shown to be good practice to graze the stock for a few hours each day, this treatment having a marked influence on the milk yields.

Grassland Management.

A new system of grassland management, which was first adopted in Germany, has been successfully applied to large areas in the British Isles. It has also been applied with highly satisfactory results in New Zealand, and to a very limited extent in parts of Victoria. This system has passed the experimental stage and a sufficient measure of success has been obtained in Victoria to prove that its benefits may be extended to districts having a sufficient rainfall or a regular supply of water for irrigation. Briefly, the system consists of the subdivision of the pasture land into small grazing areas, stimulating the growth of grass by the application of fertilisers, in which nitrogenous manures play an important part, and heavy rotational grazing so that the stock are continuously feeding upon young, nutritious herbage. The results of British experiments demonstrate that the application of nitrogen in the early part of the year provides grazing at an earlier date that normally. In some instances grass has been obtained as much as six weeks earlier than usual. This is of the greatest importance on dairy farms, for the shortening of the period of winter feeding effects a considerable saving. On sheep farms, where the new system cannot be applied in its entirety, a dressing of nitrogen on some of the land to ensure early feed for the ewes and lambs is a sound proposition. Where nitrogenous manures are used it is essential that the balance of other constituents, particularly phosphates, must be maintained. A sound practice is to topdress the pastures with superphosphate in the autumn and to apply the nitrogenous fertiliser in June or July.

In all trials the stock-carrying capacity of the land has been greatly increased, and this has been more marked where the land has been poor and the grass of low feeding value. The increased stock-carrying capacity of intensively treated pastures is due to improvement in the quality of the herbage, and also to the increase in quantity. Experimental work at Cambridge has shown that young grass has a composition on the dry matter basis very similar to a concentrated food, equivalent to linseed cake and vastly superior to meadow hay. The dry matter in meadow hay contains 12 per cent. crude protein and 31 per cent. starch equivalent. Young pasture has 25 per cent. protein and 68 per cent. starch; linseed cake, 28 per cent. protein and 72 per cent. starch. This gives a chemical explanation for the importance of close grazing, which ensures that the herbage is always eaten in its youngest and most nutritious condition. It has been proved that the quality of the herbage is maintained throughout the whole grazing season, showing no evidence of the reduced feeding value that is usually a feature of ordinary grazing.

High Quality Herbage.

One of the most valuable features of this new system of pasture management is the high nutritive quality of the herbage. Approximately 75 per cent. of the constituents are digestible in the short, growing grass, and such grass is capable of maintaining a cow in profit throughout the season, but the protein content would be higher than is required for milk production. The possibilities for dairymen are considerable. Under ordinary conditions pasture is greatly lacking in protein, and the dairyman's bill for concentrates is a large item in his yearly production costs. If the stock-carrying capacity of the land can be increased—in British experiments it has been doubled—and at the same time a protein-rich and highly digestible natural food can be grown, it would result in a very large increase in production, with a great saving in cost, for protein foods are the most expensive to purchase. The use of concentrates is particularly necessary when stock are being fed upon cereals or meadow hays and silage, for all of these foods are deficient in protein. On the other hand, if portion of the feed be obtained from young pasture, a wholesome and well-balanced ration would be obtained and the cost of expensive concentrates saved.

In the British experiments milk produced by cows under intensive pasture management has not shown any depreciation in quality, and the butter throughout the season has been characteristic of the choicest early grass butter. From the absence of bone trouble in the cattle it would appear that, as long as the basal dressing of phosphates (and lime if required) is applied there would be sufficient lime and phosphorus in the grass. The mineral matter in a young plant is always more readily available than in older plant tissue. For the successful application of this system it is essential to have pasture plants of perennial habit, such as rye grass, cocksfoot, meadow grasses, crested dogstail, and so on. Clovers do not respond to nitrogenous dressings, but when pastures are intensively grazed the increased amount of light enables the clover to meet the stronger competition, and there has not been any evidence of clover diminution.

Formation of Clubs.

The professor of agriculture of the University of Melbourne (Professor Wadham), the superintendent of Agriculture (Mr. Mullett), and Mr. E. Jackson on March 23 discussed suggestions for the formation of pasture improvement clubs with the president of the State Schools' Horticultural Society (Mr. F. A. Moore) and the supervisor (Mr. F. A. Hughes). At a meeting of the committee of the society at Hughesdale on March 26 proposals were submitted for the establishment of pasture improvement clubs at State schools throughout Victoria. Appreciation was expressed of the offers of assistance in an advisory capacity made by Professor Wadham and Mr. Mullett.

The committee confirmed a resolution passed at a previous meeting authorising the formation of pasture clubs. It was resolved that the basis of the movement should be the education of children in pasture improvement and management, and attempts to arouse the interest of all concerned in each district. Local committees of farmers and residents will be formed. The committees will elect their own chairmen, and teachers will be asked to act as secretaries and executive officers. The co-operation of the district committees will be sought in the preparation of the land, which will be at the schools, or as near to them as practicable. An area of one square rod will be adopted as a unit, and the committees will be asked to advise in the practical technique of sowing, manuring, &c. The committees will arrange also for visits to properties upon which pastures have been established successfully. The secretaries will receive all seed and fertiliser from the society, and keep records of work done, rainfall, &c., and report at least half-yearly to the supervisor. The district organiser upon the occasion of his visits will be asked to inspect the plots.

It is proposed, if possible, to establish unit plots in at least 10 schools in each of the 30 districts associated with the society, and to encourage the children to establish similar plots at their homes. Farmers, or members of the local committees, will be invited to establish supplementary larger plots, to be developed upon a commercial scale, and made available for inspection and demonstration.

Practical Help.

On March 17 Mr. E. Jackson wrote to the editor of "The Argus" stating that some expense would be incurred in the formation of pasture clubs, and enclosed a cheque for £5/5/, which was forwarded to the secretary of the State Schools' Horticultural Society.

On March 18 a letter was received from the secretary of the Commonwealth Fertilisers and Chemicals Ltd., expressing sympathy with the movement and an offer to present up to five tons of various fertilisers, such as superphosphate, super, and ammonia mixture, and basic phosphate for small experimental plots to be laid down by members of the proposed clubs.

On April 2 Nitrogen Fertilisers Proprietory Limited advised that they would be very pleased to make available up to one ton of sulphate of ammonia for top-dressing purposes. Delivery of the quantity necessary could be made at any time to any central depot.

Members of the Seed Merchants' Association of Victoria, at a meeting on March 27, expressed hearty approval of the project for the formation of pasture clubs in State schools, and promised to supply the seed required for the purpose of initiating the movement. The members present were Messrs. James Railton, T. Purves (of F. H. Brunning Pty. Ltd.), H. C. Blott (of Law, Somner Pty. Ltd.), H. F. Gill (of Gill and Searle), T. A. Browne (of Watters and Son), and absentee members, Messrs. C. Williams (of Farmer and Co.), and W. J. Purves, also promised support. It was agreed that all would contribute seed and forward parcels as required to the supervisor of the State Schools' Horticultural Society (Mr. F. A. Hughes). The seed would then be distributed by the society in packets marked "Seed Supplied by the Seed Merchants' Association of Victoria." It was agreed to supply seed of the following pasture plants:—English rye grass, cocksfoot, Wimmera rye grass, white clover, and subterranean clover. Every care will be taken in the selection of the seed to ensure that material of the best quality will be forwarded.

All members emphasised the need for early sowing, and expressed the hope that the work would be put in hand immediately, so that if seasonal conditions prove favourable all seed would be put in by the end of April.

Seeding of Plots.

The following instructions for the successful establishment of pasture plants from seed has been supplied by Professor Wadham, of the Melbourne University:—

Remember that grass and clover seeds are very small. Consequently the young plants commence life with small reserves of food. Unless therefore they germinate under the most favourable conditions for the development of the young roots and leaves, they will fail to establish themselves and must die.

The seed itself must be living. (Seeds can be tested before being sown.) Many grass seeds lose their power of germination after a year. Samples of clover seeds on the other hand usually contain a number of so-called "hard" seeds which will only germinate after their seed coats have become rotten or are scratched or broken.

The seed bed must be carefully prepared. It should be very fine in texture, free from stones, and well compacted, so that there are no air pockets below. (In such pockets young roots will dry out and the plants will not establish themselves.) On the other hand, the seed bed must not be too hard or the young roots will not penetrate easily.

The seed bed must be moist. If plenty of water is available, this moisture can be applied artificially. Otherwise it is necessary to wait until weather conditions have moistened the seed bed thoroughly.

Care should be taken that the seed bed is not moistened patchily, if such is the case some seedlings will receive too much water and some too little. The former will die by drowning and the latter by drying out.

The amount of seed sown must be carefully watched. It is not easy to distribute small quantities of seed evenly over a seed bed. As a rule the best procedure is to mix the seeds and whatever artificial manure is to be used with a quantity of dry, sifted sand. The whole mixture is stirred thoroughly until it is uniform. Care is taken that there are no lumps in either manure or sand. The mixture is separated into four equal parts and the area to be sown is similarly divided off. Each quarter area is then sown with one of the quarter quantities. In this way, much more even distribution can be obtained than by sowing the whole at once. If the farmer is in doubt as to how thickly to sow, he can make a trial sowing with sand alone.

The bed is now either sprinkled evenly with a thin layer of sifted earth or very lightly raked so as to bury the seed. The seedlings are small and before they can grow, they must lift up or break through whatever is between them and the light; consequently if they are covered too deeply or if the soil "sets" too hard on them, many will fail to come through.

After covering the seeds, the surface should be rolled or compacted with a spade to draw moisture up from the deeper soil to the seed. This compaction should be distinguished from the "setting" effect which some soils show on watering.

Much depends on the water supply which the seedlings receive in their early stages of development. If they are "overwetted" they are easily drowned—they must have some air to live. If they do not get enough water, the seed coats burst and the small roots emerge into rather dry air, shrivel, and nothing further happens. It is suggested that those teachers who are accustomed to watching the weather maps and who have experience in making rough forecasts of the weather for their district several days ahead may find such knowledge very useful in deciding when to sow.

In some areas where soils tend to set hard on the surface, the young seedlings, a few days after planting, will be found to be raising the surface crust in masses rather than breaking through it. This condition can be dealt with by watering lightly and very gently breaking the crusts with a rake, thus allowing the seedlings a better chance of life.

The young seeds are tasty morsels for birds, and, as the plots are easily seen owing to their isolation, some attempt must be made to avoid bird damage. The usual gardening devices of suspended mirrors or tin strips or paper, and better still, the use of black thread just above the surface of the ground, will often be found necessary.

There are many factors, some of which will be disturbing in one district, some in another. It is thought that intelligent use of these notes will give good results even in the hands of those who have never before tried to plant grasses. There will be failures, even when all the precautions mentioned are taken. The climatic factors cannot be controlled, and they are of very great importance. It is for this reason

that laying down land grass is one of the most difficult and critical of all agricultural processes.

Having decided to set out on the cultivation of pasture plants, the first point to decide is where they are to be sown. It is very advisable that an even piece of land should be obtained, and that it should be free of weeds. If it is not fairly free, the land should be broken up and worked down with spade, hoe, rake, &c., to a depth of a few inches. If the soil was moist, the weeds will now germinate, and the resultant plants can be removed by hoeing. If the ground is not moist it can either be artificially watered or it will be necessary to wait for rain. Most weeds are vigorous plants, and will compete very successfully with the young grasses as they emerge from the ground. It is therefore essential that these weeds should be got rid of.

The second point is to decide what comparisons you wish to make, and to allot your land in the best possible manner for this purpose.

The next point will be the time of sowing. The young plants will not be able to grow rapidly during the cold winter months, especially in hilly districts. Winter sowing is therefore to be avoided. The next point is concerned with the amount of seed and manure to be used. As a general rule, 1oz. of grass seed will be required for every five square yards sown, while for clover seeds about half that quantity will usually be quite sufficient. Where it is desired to use superphosphate, 1lb. per 10 square yards will be sufficient dressing, and if ammonia sulphate is also to be applied, ½lb. per 10 square yards will be a reasonable rate.

It is suggested that the standard plot should be cut with a mower and the produce cured by drying in a shaded position and afterwards weighed. By this means the total weight of produce could be recorded. Specimens should also be reserved for exhibition. To maintain a perennial pasture for the best economic results in feeding, the plants should never be allowed to seed.

Some Recent Advances.

Work of the Plant-breeder.

By PROFESSOR S. M. WADHAM.

I.

"Nebuchadnezzar was driven from men and did eat grass as oxen."—Daniel iv. 33.

The study of Holy Writ is perhaps scarcely as popular as it was, yet even in 1930 no one reading my quotation can fail to be arrested by the novel statement it contains. Some readers will be sympathetic with the unfortunate King; some will be merely contemptuous; the scientifically minded will be curious as to the effect which this diet had upon the organs of the King. Most men are rather contemptuous of the food of animals—just as the gardener who collects the lawn clippings from the mower-box, and languidly stacks them on the rubbish-tip, scarcely realises the highly nutritious nature of the material which he is throwing away. Man, as usual, sees these things from the viewpoint of his own digestive system. The extremely high nutritional value of good young grazing material, when used in the alimentary canal of the herbivore, has been demonstrated only recently. The graziers of past centuries have known that stock made good progress on good pastures, but the fact that a young growing paddock is really a vast delicatessen store to the ruminant is a new idea. Naturally the question how to use it to the best advantage has become very pertinent.

The detailed scientific investigation of crops has been proceeding for nearly a hundred years, and during the last four decades these studies have become more and more intense. The most recent developments have all been in the direction of the intimate study of the life of the plant as it grows under field conditions—in other words, the biological aspect has been coming to the fore. In view of the enormous importance of the grazing industries it is strange that the steady scientific study of pastures should have lagged behind that of the field crops. Yet a few minutes' thought reveals the reason. Most paddocks of crop plants are of one type, and a crop is usually a thing of a season; it may be readily observed at all stages, from planting to harvesting, and the effect of manurial or climatic conditions may be noted and deduced with some degree of accuracy. On the other hand most grazing paddocks are covered with a fair number of rather different plants, with different characteristics of growth. These species and varieties are almost inextricably mixed with one another, and they react on one another both above and below ground. Further, the action of the grazing animal affects the balance of the plant community, and also of the plant itself. Again, many of the plants are perennials, and the happenings of one season may make profound differences to their behaviour in the following year. In these circumstances the ordinary scientific methods of analysing a problem into its constituent parts and then rebuilding the completed picture from its components are somewhat difficult to apply.

Experimentation and Practice.

It is essential that any general experiment should imitate the conditions under which the pasture is to be used. It would not be of great value to study a grazing paddock by letting all the plants grow unmolested by the animals. Some means of imitating the animal must be found if we are to study the productivity of pastures quantitatively. It is very difficult to use the animal itself, because we cannot be sure of the amount it really eats. If we supply a mowing-machine it fails to imitate the selective habits of the animal; in fact, it may select in quite a different way; further, it makes no manurial return, as does the animal, to the paddock. It follows then, that although experimentalists may have to use mechanical imitations of grazing, their results have to be interpreted with a certain degree of caution.

Few realise the strides which have been made by experimental science during the present century. In every branch technique has been developed, enabling practical use to be made of the knowledge which has been accumulated by other branches. There has been a gradual movement of the focus of botanical thought from the academic study of the plant as a museum or garden specimen toward the examination of the actual mechanism of its life and development in relation to its surroundings. Botany has been gradually freeing itself from the shackles laid on it by the post-Darwinian intensity of interest in the evolution of form and structure. Methods of studying vegetation have been developed. The chemical examination of organic material has been rendered more accurate and more rapid. The scientific principles underlying the feeding of animals have been worked out. Finally, methods of ascertaining the effect of foods on the animal itself have been expanded. For instance, in some of the more recent pasture experiments, two sheep were kept in cages for two periods of 14 days each, each period being separated from the next by an interval of three days only. During each of these periods, the animals were fed on material taken from a pasture of certain type. The quantity and composition of the food was accurately known, and all excreta from the animals were collected and sampled twice a week, each sample being fully investigated. In this way it was possible to determine with considerable accuracy the use made by the digestive apparatus of the animal in dealing with each class of chemical component of the foodstuff. Such an experiment required exceedingly careful preparation and execution, but it is illustrative of the pains which are now being taken to free agricultural investigations from the criticism of lack of thoroughness and detachment from practical requirements.

It may be urged that sheep do not live in cages, but roam abroad, and that the conditions under which these animals lived were artificial. However, the observations were carried out with minor alterations for three successive seasons, each extending from April to October, and every sheep remained healthy and put on a certain amount of weight during its periods of close confinement. Again, accurate observations of the behaviour of animals, and of the amounts of food and energy they consume and use during the processes of walking about, sleeping, and so forth, have been made, and nowadays the student of nutrition regards the animal in much the same way as an engineer regards a machine. Its efficiency in dealing with various feeds is studied as closely and known almost as well as is the efficiency of a boiler in which various fuels are consumed. The details of dietetics have ruined the romance of rumination.

In Australia detailed experimentation with the living animal has as yet merely begun, but it is clear that as economic forces press more closely on the grazing industries it will be necessary for them to use the wide areas at their disposal to the maximum advantage possible, and in this way it may be expected that, where possible, more careful and judicious use of the pasturage will become imperative. In some cases it is possible that results of far-reaching importance will be achieved.

Diversity of Grazing Types.

The first point which has to be made in a consideration of grazing methods is that in the broad expanse of the Commonwealth there is a wide diversity of climatic conditions. The annual rainfall shows wide variation both in amount and reliability; moreover, the maximum precipitation is in the hot season in some districts and in the colder months in others. These factors have their repercussions on the plants, for every variety of plant has its own method of existence, which enables it to thrive in its own appropriate habitat, in much the same way as the Esquimo, the Bedouin, the Parisian, and the New Yorker have their habits, which enable them to exist in their own surroundings. The only possibility of a successful migration from one habitat to one of the others depends on the exercise of conscious mental processes. There is no evidence that plants have any consciousness. The first necessity is, therefore, the recognition of the broad groupings of grazing plants and grazing habitats. Consequent on this is the realisation that experimental work which is applicable to one type of pasture will possibly have no significance to another. A broader understanding of each type is necessary; when that has been attained it should be possible to investigate the conditions limiting the growth of the chief plants. From such a study it may be possible to alter such conditions by the application of methods which are not too expensive to be unremunerative.

A second point of importance lies in the possibility of introductions. The past furnishes numerous instances of the strides which have been made by the introduction of forage plants from other countries. Paspalum dilatatum and subterannean clover are obvious cases which have made a great difference to their appropriate districts. The United States has imported some of our saltbushes. It is conceivable that an extended search for likely plants would yield valuable additions to the material of the pastoralist. Further, a close study of the plants which we already have will probably reveal possibilities of extending the range of some of the more valuable to districts which they have not at present reached. After all, the rural development of Australia is comparatively

recent, and there is no reason to suppose that the most advantageous distribution of plants or the most efficient methods of using the land have been evolved up to the present time. England has had grazing areas for more than a thousand years, yet it seems to be clear that valuable improvements in grazing practice in certain districts have been discovered during the last few years. For this reason, among others, the Commonwealth is setting up a bureau for the purpose of investigating the introduction of plants.

Plant Breeding and Selection.

When the advances which have been made by plant breeding and selection in connection with the grain and vegetable crops are considered, it is natural to expect that the plant-breeder will be of assistance to the pastoralist. There are, however, greater difficulties in the way than has been the case with most of the cereal plants. The principal races of wheat, barley, and oats are usually self-fertilised plants; consequently, when once a type has been selected and "fixed," it automatically remains "pure" provided the seed is carefully harvested and stored. Many of the grasses and clovers are cross pollinated, so that keeping a race pure is a matter of considerable difficulty. Again, the flowers are very small, and they do not readily lend themselves to the intricate operations of artificial hybridisation. However, sometimes artificial selection on the mass scale is carried out automatically by methods employed in harvesting seed. To take the instance of perennial rye grass, this valuable pasture plant when grown from bulk seed really consists of a whole complex of forms differing in several different ways, some of which are morphological and some purely biological. Some plants in the paddock will have a great tendency toward the perennial habit; these usually flower scantily in the first two years of their growth. Other plants will have a biological constitution, which makes them shorter-lived, and, therefore, less valuable in a pasture which is intended to be permanent; these plants usually produce an abundance of seed during the first few years of their lives. It follows that, when introducing perennial rye grass seed, the former type is the more desirable, and also that seed crops taken off a paddock during the early years of its growth will tend to contain but a small proportion of seed of this type. Incidentally it may be remarked that, if a farmer is setting out to produce rye grass seed, and is in a hurry to market a crop, he will be sorely tempted to put the less valuable material on the market. By waiting two more years he could produce an article which is in reality of much greater value, though, unfortunately, there is nothing in its external appearance to indicate the fact. This instance is merely quoted as one in which mass selection is carried out by the farmer. Practices of this kind will probably be found to be of considerable importance in the production of desirable strains of many forage plants.

Lines of Investigation.

Overseas Experiments.

By PROFESSOR S. M. WADHAM.

II.

In the management of grazing on pastures there is a vast field for study, the boundaries of which are as yet but dimly recognised. It is possible that in this there lies the key to great increase in production per acre. The subject has been coming to the fore rapidly during the last decade, and naturally it has received most attention in European countries in pasture districts which have a fairly high rainfall. The first stage was the appreciation of the benefits of intermittent grazing in regions of this type. It has now become the practice to divide the estate into reasonably small paddocks, each of which is grazed intensively in turn. In this way the herbage, after having been reduced to small dimensions, has the opportunity of building up a considerable body before the next attack of the animals begins. This is a logical process, for it is necessary to remember that the leaves of the plant are its factories for the manufacture of much of the material of which its body is made. If these leaves are constantly removed—and animals, particularly sheep, have the habit of selecting the young succulent leaves in their search for food—the plant is automatically prevented from making the progress which it would otherwise be able to achieve.

The scientific attitude toward intermittent grazing may be summed up in a series of questions:—

(1) How does it compare, in respect to the bulk yield obtained, with other practices, such as cutting the herbage for hay at the period of peak production?
(2) To what extent do the results vary with soil and climatic conditions?
(3) What is the actual nutritive value to the animal of the material obtained by these different methods?
(4) Has the material obtained by various methods of management, the general chemical composition which is most satisfactory for the particular class of stock which is being fed on it?

Apropos of the last question, it is perhaps necessary to explain that different types of feeding material, besides differing in digestibility, also differ in the amount of fat-forming and muscle-producing substances which they contain; further, the relative proportions in which these substances ought to be present in the food of young growing animals are different from the proportions in which they ought to occur in the food of "store" animals.

Naturally, if this ratio be not followed in the feeding there is bound to be some waste of the particular material which is in excess. The more this waste can be avoided the greater the economy of the foodstuffs. The grazier is in some respects like the caterer who has contracted to provide food for the maintenance or rearing of a certain number of persons. If the caterer gives too rich a diet he receives no more than if he gives one which is just adequate. The recipients of his food may be pleased, but he, having made a contract, receives no additional return save by advertisement. The grazier also who gives his sheep a richer diet than they require also receives no extra return, and, further, he receives no advertisement, because there is no evidence that an over-fed sheep is more marketable or produces more wool than an adequately fed animal.

Some Cambridge Experiments.

The most complete set of experiments designed to ascertain the answers to these questions for a specific district has been conducted at Cambridge during the last few years. The work was done on the University farm on paddocks well known to me. A beginning was made in 1925, when an area of about an acre in a grass paddock on light soil was fenced off and divided into seven equal plots. In turn each plot was cut with a mowing-machine, one plot being cut every day. This treatment thus represented intermittent grazing at seven-day intervals, and it was continued from spring till autumn—April 14 to October 29. The feed produced in this way was carefully collected and weighed. Simultaneously comparable adjacent plots were allowed to come to the flowering stage and cut as a hay crop; subsequently the aftermath on this hay area was "grazed" by the mowing-machine. Representative portions of every week's produce on both pasture and hay plots were analysed chemically, and the digestibility of the various chemical constituents of the pasture crop was obtained by feeding to sheep in the manner already described. Briefly, the result showed that whereas the total amount of material produced from the hay plot was rather more than twice that produced from the "grazed" plot—6,738lb. per acre as opposed to 3,065—the decrease in nutritive value of the material was very marked. Thus, whereas true protein, which is muscle-forming food, in the pasture cuts varied from about 18 per cent. to 23 per cent., in the hay crop it was only about 7 per cent. Again, the grazed material contained rather less of those chemical portions which are principally concerned with the maintenance and fattening of the animal than did the hay crop, but the difference was chiefly due to the higher amount of fibre in the hay. This is a reflection of the fact that as grazing material passes into the hay stage the process of lignification becomes relatively rapid, and is cumulative. When the digestibility of the various foods was investigated the extremely high quality of the material from the pasture became apparent. The investigators point out that the nutritive value of the green material obtained from a pasture by intermittent grazing is very nearly as great as that of the more highly concentrated foods used for fattening animals in European countries. It has rather less fat and fibre than linseed "cake," but is otherwise as satisfactory. In general these results showed the principle of intermittent grazing to be a sound one on the soil and in the climate concerned.

The next investigation was designed to make the same experiment on a heavier soil; it was carried out in 1926, which proved to be a very different season climatically. Whereas 1925 had had a dry period of about a month in the middle of the summer, in 1926 the only really dry spell was in the spring. In general the results were of the same order as those of the preceding year; once more it was clearly shown that for obtaining the maximum quantity of nutritive material intermittent grazing was a sound principle.

Fresh Avenues of Thought.

Several new avenues of thought were opened as a result of these investigations. One was that mown grass clippings, dried and stored, would be splendid concentrated food. The obvious difficulty lies in the provision of economical machinery for carrying out the work. Another was that the ratio of digestibl. protein to digestible carbohydrate in the grazing is really too high for all save perhaps very deep-milking cows and young growing animals. Now, in general, the protein part of foodstuffs is the more expensive. Can the grazier, by lengthening the interval between successive grazings, contrive to obtain a greater bulk of material from his paddocks and also at the same time to produce a food which is more economic nutritionally? In 1927 a further trial was carried out with fortnightly cuttings, but this extension was apparently not long enough, as the results still showed an "unbalanced" ration. Further results from experiments planned on a wider basis will be followed with interest.

A third interesting speculation follows from grassland inquiries of this type. If the total quantity of herbage produced week by week from the plots is examined it is frequently found that the plants give a weekly yield of herbage, which increases week by week in the early spring, finally reaches a maximum, and then gradually falls off in the summer; under some condition—and this is largely influenced by the actual species composing the grazing—the yield rises again in the autumn. To what are the variations in the amount due? To say that they are due to an inherent quality of the plants, to a periodicity which is natural to them and cannot be modified by man is really to confuse the issue.

The emergence of plants from a dormant or semi-dormant state into one of activity is far more frequently due to the operation of external factors such as moisture, temperature, food supply, and so on, than to

any inexplicable internal factor. It is certainly true that in the dry summer growth is retarded by lack of moisture, and in the winter low soil temperatures may retard growth, but it is not clear that the mere coldness of the ground alone determines the rate of growth in early spring. The supply of salts from the soil may equally well be a retarding factor. Of these salts several are necessary. Phosphates, potash, and nitrates are those most likely to be deficient. Phosphates are fairly generally added in the moister regions, which are now under discussion; our soils usually contain sufficient supplies of potash, but nitrates are largely formed by the activity of soil micro-organisms, and the intensity of action of these certainly does vary with soil temperature. It may, therefore, be that an addition of nitrogenous fertilisers would give increased growth of the pastures in the early spring. Similarly, the falling off in the productivity in late spring may perhaps be obviated to some extent by similar means. Experiments in Europe and New Zealand have given positive results in some seasons, and preliminary trials in Australia are certainly encouraging. It remains for the future to demonstrate whether the cost of producing the extra growth will be repaid by the additional grazing material obtained. The necessity of feeding the plants which feed the sheep has already been recognised in many districts by the application of superphosphate. But inasmuch as phosphates are only one of the plants' necessities there is no logical reason why the others should not also, in some cases, need attention. Every soil and pasture type will require separate consideration, and in every case the economic factor must be borne in mind. This is equally true of superphosphate, the addition of which to land of very light carrying capacity is scarcely a paying undertaking.

Comparison with Australia.

The series of experiments described cannot at once be translated and used for Australian conditions. They have been quoted as being indicative of the lines which work will have to follow in this country. In some of our southern areas the conditions are not so very dissimilar from those which prevailed at Cambridge in 1925, and in order to illustrate the point the following table has been drawn up. It makes a comparison with the rainfall during each summer month for the last 10 years at Penshurst, which is a fairly characteristic sheep-carrying region in the Western District Victoria:—

It can be seen that during the last 10 seasons there have been three (1920-21, 1926-27, 1927-28) in which there is reason to suppose that the same type of European pasture as was used in Cambridge might be expected to have made a successful growth; two other seasons (1919-1926 and 1926-1927) would have been reasonably satisfactory, while the other five would have very severely tested the endurance of these plants against drought conditions. English grasses are cultivated in some places in the district, and they do occur more or less wild here and there, but the great majority of the pasture is composed of native species, of which Wallaby Grass is a characteristic type. It will be necessary to ascertain for each type of pasturage the probability of its survival under grazing for each climatic district and each soil type.

PENSHURST SUMMER RAINFALL IN POINTS. Cambridge.

Season.	1919-20.	20-21.	21-22.	22-23.	23-24.	24-25.	25-26.	26-27.	27-28.	28-29.	1925.
December	109	135	159	268	242	72	46	73	151	40	May, 196.
January	40	140	42	33	121	76	94	89	270	0	June, 35
February	31	12	26	46	332	72	11	99	383	117	July, 142
March	231	228	47	14	180	22	52	105	158	98	Aug., 204
Totals	411	565	274	361	875	242	203	366	1062	255	577

(The average rainfall for these four months is 461.4 points, which at first sight seems fairly satisfactory. It is one of those cases where an average is deceptive, for in the 10 years shown it has been exceeded only three times, and has not been reached in the other seven years.)

Crux of the Problem.

Skilled Workers the Need.

By PROFESSOR S. M. WADHAM.

III.

Those grasses, which occur naturally in districts with dry summers and moist winters, fall into two groups, and each group possesses a means of dodging the dry summer. The first group, which contains the wallaby, kangaroo, and many other species, has the habit of retaining vitality in its basal portions when its above-ground, leafy regions are dry and dead. Provided it is not over-grazed, it will grow again and form new green leaves as soon as the first rains revive the roots into fresh growth and activity. The second group consists of annual plants which grow from seed in the autumn and flourish during the spring. With the onset of the annual dry season they flower, form seed, and die. Characteristic and valuable species of this type are Wimmera rye grass and subterranean clover. Less valuable forms are rat's tail fescue and barley grass, which never attain the luxuriance of the other two. It is

necessary to keep these two subdivisions, the perennials and the annuals, distinct. Their method of dealing with adverse circumstances is fundamentally different, and it is reasonable to expect that different courses of management ought to be applied to them by the grazier if he is to procure the best results.

In the case of the perennial type, as exemplified by wallaby pastures, over-stocking during dry autumns will weaken the plants, and may deteriorate the pasture and allow undesirable weeds to obtain a hold. The problem of how to get the maximum amount of grazing material compatible with safety from areas of this kind should be soluble by experimentation along the lines used at Cambridge, which I described yesterday. The question of the application of artificial manures of one kind and another will also require careful investigation over a number of years in various districts.

The problem of the annual types is in some ways different. The plants grow from seeds, which contain a smaller amount of reserve food than a dried root system. Consequently growth is bound to be slow during the early stages of the plants' lives while they are building up their assimilative machinery. Subterranean clover may be taken as an example; this begins as a small seedling, builds a rosette-shaped plant, and later produces a number of long, creeping, leafy stems, which make wonderful feeding material. In "early" seasons the plants may enter on this stage of rapid growth before they are checked by the winter's cold; in "late" years this transition will not occur until the spring. The discovery of any means of forcing this early growth or of races which will possess the character naturally will be of great value. Manuring, occasional cultivation, and great care in grazing during early stages of growth, are manifestly possible avenues of approach to a solution. Another point of importance with this class of pasture is the power of the plants to seed. The permanence of this pasture type depends upon the production of a certain amount of seed by the plants in the spring and the subsequent germination of that seed in the autumn; naturally grazing practice in the spring must be adjusted so as to allow for some seed production, just as autumn management must have early and successful establishment of the plants in view.

In some districts where these two types occur mixed together it is conceivable that proper management should endeavour to treat them as distinct types, and that the careful graziers of the future in such areas will have some paddocks managed to suit the perennial grasses, and some managed to suit the annual herbage.

Necessity for Investigation.

These instances have been mentioned in some detail because they have already begun to occupy the attention of students of agricultural problems in more southern parts of the Commonwealth. Farther north, in the areas where the summer rainfall is greater than the winter, other grasses form the bulk of the pasture. These have life histories and growth habits which are in accord with such climatic circumstances. Each pasture type has its own zone of climate and soil, and each presents its own problems, which can usually only be worked out in the appropriate district. In some cases, at least, it is to be expected that intermittent grazing will be found to be a boon; in others, manurial treatments will probably lead to definite results. Always it is the biology of the plants which compose the pasture, their interrelations, and their relation to their surroundings, which must be the focus of attention.

Finally there are the drier areas in which the saltbushes and certain trees form the bulk of the grazing. There is every indication that judicious management of this type of pasturage is essential to success. Fortunately the study has already begun, and the work at the Koonamore Vegetation Reserve initiated by Professor T. G. Osborn promises to explore the capacity of the saltbush type. It is perhaps rather too much to say that intermittent grazing is also a necessity here, but it is clear that if on the one hand the plants are allowed to grow too big, they may crowd one another below ground if not above. Again, if they are grazed too closely, and too much of their assimilatory machinery is thus removed, they cannot be expected to produce as much material as if they had been kept to a proper size. It should be possible to discover an intermediate stage which would lead to the best results.

Work of the Future.

Enough has been written to indicate the vast field of work which lies before investigators into the complex subject of Australian pastures. In the past the grazing industry has focused its chief effort on the problem of the animal with the success which the world knows. In the future advance will largely be due to a greater appreciation of the problems of the plants which feed the animal. Unfortunately, at the moment, the number of investigators available is small and their equipment none too generous. Incompetent or badly trained workers will merely confuse the issues and hinder progress, while competent observers cannot be called into existence at even two or three years' notice; nor will able men offer themselves for the work unless reasonable inducements are held out to them. If there is any measure of agreement among those who direct the policy of the industry there is surely sufficient drive to ensure that the work will be carried out.

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